Small Business Innovation Research/Small Business Tech Transfer

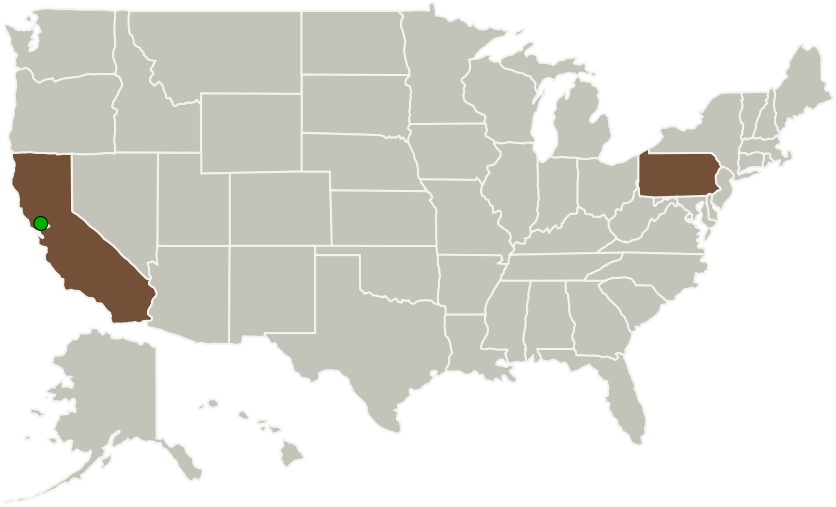
Evidence Meshes for Three-Dimensional Modeling, Visualization, and Navigation, Phase I

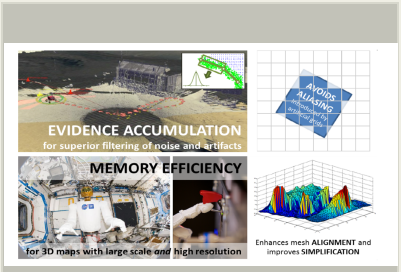
Completed Technology Project (2017 - 2018)

Project Introduction

As robots are tasked with ever more complex missions, they demand more sophisticated models of the environments in which they must work. Rough-terrain mobility, site surveying, and dexterous manipulation all demand a fully 3D map of the world that simultaneously exhibits large scale and high resolution, a situation we refer to as scale disparity. Most robots discretize the world into a uniform-grid that is used to accumulate evidence from multiple measurements. Unfortunately the memory footprint of such maps grows dramatically with scale disparity. Octrees can lessen memory requirements, but do not fully counteract the exponential growth of the underlying grid representation. In response, we are developing a map representation called an Evidence Mesh that provides the benefits of probabilistic treatment of evidence but performs better under scale disparity. It is based on a triangulated mesh and is compatible with well-known simplification algorithms to represent the shape of objects at adjustable levels of fidelity. Like an evidence grid but unlike other mesh-based mapping methods available today, an Evidence Mesh accumulates evidence about the location of objects through simplification and across multiple sensor measurements, enabling robust noise filtering and avoiding artifacts and aliasing introduced by artificial grid structures.

Primary U.S. Work Locations and Key Partners





Evidence Meshes for Three-Dimensional Modeling, Visualization, and Navigation, Phase I Briefing Chart Image

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Organizations Performing Work	Role	Type	Location
Mesh Robotics, LLC	Lead Organization	Industry	Pittsburgh, Pennsylvania
Ames Research Center(ARC)	Supporting Organization	NASA Center	Moffett Field, California
Carnegie Mellon University	Supporting Organization	Academia	Pittsburgh, Pennsylvania

Primary U.S. Work Locations	
California	Pennsylvania

Project Transitions

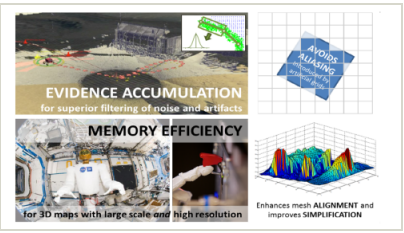
June 2017: Project Start

June 2018: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/140854)*

Images



Briefing Chart Image
Evidence Meshes for Three-Dimensional Modeling, Visualization, and Navigation, Phase I Briefing Chart Image *(https://techport.nasa.gov/image/132790)*

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Organization:
Mesh Robotics, LLC

Responsible Program:
Small Business Innovation Research/Small Business Tech Transfer

Project Management

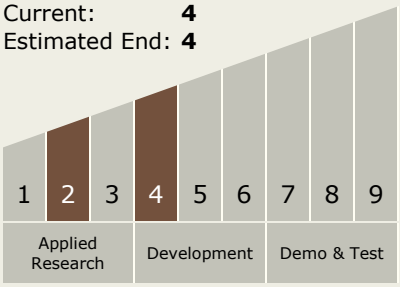
Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
David Wettergreen

Technology Maturity (TRL)

Start: **2**
Current: **4**
Estimated End: **4**



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Technology Areas

Primary:

- TX04 Robotic Systems
  - TX04.1 Sensing and Perception
    - TX04.1.3 Onboard Mapping and Data Analysis

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System